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An exploratory investigation was made of cross-modality matching within the context of word recognition skills among beginning adult readers. The specific aim of the study was to assess the possibility that a deficit in cross-modality matching might be potentially useful as a diagnostic and predictive indicator of the rate at which adults learn to read. Subjects were 178 adults enrolled in basic reading classes in Flint, Michigan. Prior to collection of data, all students were given the Adult Basic Reading Inventory. Although only 31 of the subjects remained for the retest, the proportion of dropouts was about the same for the original high and low groups. The word recognition tasks involved the comparison of words under four conditions and two types of judgments: (1) auditory-auditory match, (2) auditory-visual match, (3) visual-auditory match, and (4) visual-visual match. One judgment involved responding to two words and indicating whether they were the same or different. The other judgment involved the presentation of one word, then the presentation of two words, with the subject indicating which of the two words was the same as the stimulus word. Results showed that the better reader made more use of the visual-visual match; the less proficient reader utilized cross-modality comparisons. References and tables are included. (WB)

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Auditory and Visual Word Recognition in Beginning Adult Readers[1]

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One of the differences often mentioned between children and adults who are learning to read is the fact that adults are so much more experienced in listening to the language. By implication, their more extensive histories as listeners should influence the rate at which they learn to read, or--at least--should somehow alter the process in some discernible way. To say this is to state the obvious, of course, perhaps even to indulge in trivia--yet the statement very nearly exhausts our understanding of how adults integrate their knowledge of the language--gained primarily through listening--with their newly-acquired knowledge of language in its written form.

The ability to compare information across sensory modalities is very likely to be a critical factor and several investigators have been studying the way children match visual and auditory information. Among their findings is evidence that a developmental trend exists, with children reaching a plateau in their ability to integrate auditory and visual information at about nine or ten years of age (Birch and

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[1]We acknowledge the cooperation and support of Louis Schulz, principal, and Nicholas Manych, assistant principal of the Mott Adult Education Program, Flint, Michigan in organizing the study, and the help of Michael Hughes in collecting the data.

Belmont, 1965). And they have also demonstrated that among school age children, it is possible to differentiate normal from slow readers of comparable intelligence on the basis of their accuracy in comparing non-verbal stimulus patterns across sensory modalities (Beery, 1967).

In this study, an exploratory attempt was made to investigate cross-modality matching among beginning adult readers, within the quite limited context of word recognition skills. The specific aim of the study was to assess the possibility that a deficit in cross-modality matching might be potentially useful as a diagnostic and predictive indicator of the rate at which adults learn to read.

The subjects in this study were 178 adults enrolled in basic reading classes offered by the public schools in Flint, Michigan. Most were women between 30 and 55 years of age, and the group was about evenly divided between white and Negro. All had less than a grade school education. Prior to the collection of data on cross-modality word recognition, all students were given the Adult Basic Reading Inventory, and the mean score for the entire group was 99.

The word recognition task itself involved the comparison of words under four conditions and required two types of judgement on the part of the subject.

The four conditions were the auditory - auditory match, the auditory-visual match, the visual-auditory match, and the visual-visual match.

The auditory-auditory match, or the auditory recognition of a word the subject had heard a moment before, was by far the easiest of the four conditions. The subject heard a word pronounced and then, following a two-second interval, he heard another word. The

subject decided whether or not the two words were identical, and circled either the response "same" or "different" printed on his answer sheet. This same-or-different judgment we have called the single-stimulus type. Another version of the auditory-auditory match presented the listener with a stimulus word--such as "chair"--and then after a brief interval, he heard two words in succession. For example, "stair . . . chair." His task was to decide which of the two, the first or the second, was the same as "chair," and circle either the "one" or "two" on his answer sheet. This judgment was designated the "pair comparison" type. These two types of judgment were required for items under each of the four conditions.

The second condition was the auditory-visual match--the auditory recognition of a word previously seen.

The third condition was the visual-auditory match--the visual recognition of a word previously heard.

And the fourth condition was the visual-visual match--the visual recognition of a word previously seen.

There were 160 items constructed altogether, 40 for each of the four conditions, 20 requiring one type of response, 20 requiring the other type. These design details are summarized in Table 1. The order in which subjects were exposed to the four conditions was uniform, and followed the sequence listed in the table.

Insert Table 1 About Here

In constructing the items, all words were selected from functional word lists for adults and from frequency listings compiled from transcripts of spontaneous, spoken language. In order to reduce and control some of the cues which are utilized in word recognition, the words used in any particular item varied only in their initial letters. The terminal sequences

of letters were identical. This control on the complexity of the recognition task was prompted by the fact that the initial letters of a word tend to carry the most information (Garner, 1962).

Subjects were exposed to instructions and test items in a coordinated tape-slide presentation. Items followed one another in rapid succession, with about three seconds allowed for each response.

In analyzing the data, the subjects were assigned to two groups on the basis of their performance on the Adult Basic Reading Inventory. The two groups consisted of subjects scoring above and below the group mean. We next compared the profiles of the four word recognition tasks for the two groups. In Figure 1, the profiles are graphically presented for the high and low scoring groups. It is immediately apparent that the profiles are not similar in their patterns. We cannot adequately describe the performance of the below-mean group as being simply lower than that of the above-mean group. It is, of course, but even if the profiles were superimposed they would remain very dissimilar. The difference in the shape of the two profiles is statistically significant. It is also apparent from Figure 1 that the word recognition task which was most sensitive in separating the two groups was the visual-auditory mode--the auditory recognition of a word which had been previously presented visually.

Insert Figure 1 About Here

These results encouraged us to consider the possibility that poor performance in the visual/auditory matching of words might be related to poor performance in learning to read. A demonstration that this specific ability was predictive of reading level at some future time would provide stronger evidence that cross-modality comparisons play an important role in learning to read.

For this reason we retested all of the subjects who were still attending classes five months later. The attrition rate was very high, as is almost always the case in ABE classes, and we were able to find only 31 of the original 178 students--a dropout rate of about 80 percent. Fortunately, for our study, the proportion of dropouts was about the same for the original "high" and "low" groups (31 and 34% respectively). So there was little systematic bias introduced into our sample.

Using as our dependent variable, the scorers on the Adult Basic Reading Inventory collected the second time it was given, and using as our independent variables, the scores on each of the four word recognition tasks, we did a step-wise multiple regression analysis. As might be expected, the four recognition tasks--taken together--were quite good predictors of performance on the achievement test. The multiple correlation coefficient was .81.

But the order in which the four tasks were entered into the regression formula was especially interesting. The visual-auditory matching task was the best predictor of the four, accounting itself for nearly 60% of the total predicted variance.

There was a suspician, however, that the relationship between the visual-auditory task and the reading scores depended upon whether the subject was a superior or poor reader, defined in terms of this group. Thus, we further divided the group of 31 into two subgroups, on the basis of scores on the second administration of the Reading Inventory, and recalculated the multiple correlations. We found that for subjects whose achievement test scores fell below the group mean, that visual-auditory matching was still the best predictor. But for the subjects above the mean, the visual-visual task was best--the visual recognition of a word previously seen. In contrast, the visual-auditory

task was relatively unimportant. In Figure 2, we have plotted the percent of total variance for which the two recognition tasks accounted, and have placed the high and low groups side-by-side for comparison. We can see that the two tasks almost reverse roles as predictors of reading achievement, depending on the level of achievement. For the below-mean group, the visual-auditory task accounts for 73% of the predicted variance in reading achievement scores, while the visual-visual task accounts for only 15%. On the other hand, visual-visual matching accounts for 67% of the variance for the above-mean group, while visual-auditory matching accounts for only 18%. It is significant that the two tasks are rather highly correlated ($\underline{r}$ = .84) for the above-mean group, but much less so for the below-mean group ($\underline{r}$ = .34). These results suggest that the ability to match words across sensory modalities, especially in making auditory comparisons with words previously seen, is an important factor in learning to read at lower levels of proficiency. But it is a less important factor at higher levels of proficiency, where the ability to make visual comparisons of words appears to be more critical.

Insert Figure 2 About Here

Further support for our interpretation that the "listening" component in reading is differentiated from the "visual" component was provided when we examined the relationships among the recognition tasks. To graphically depict these complex relationships, we constructed a circumplex, which is found in Figure 3. A circumplex is a circular rank-ordering of tasks, so arranged that--tracing around the circumference--contiguous tasks are most highly correlated, while tests on the opposite side show lowest correlations. In a correlation matrix which exhibits a circular rank order, the correlations are largest next to the principal diagonal, which runs from the upper left to lower right hand corner. Moving away from the diagonal entry, the correlations first decrease and then begin to increase in a consistent way. This systematic

descending-ascending pattern is observed in both the rows and the columns of the matrix. The circumplex in Figure 3 shows that all three tasks with an auditory component are linked together. That is, the auditory-auditory, auditory-visual, and visual-auditory matching tasks can be rank ordered in a consistent circular fashion. Note also that the two types of responses also fit into the pattern: the "single stimulus" comparisons all occupy adjacent positions around the circumplex, as do the "pair comparison" responses.

Insert Figure 3 About Here

We believe that it is meaningful that the visual-visual task could not be integrated into the circumplex. It could not be made to fit the pattern--a fact which suggests that visual matching may not involve any mediating auditory component. Visual matching, may, in fact, be a separate skill which influences the rate of learning in readers at a relatively advanced stage, but which--at an earlier stage--is of secondary importance. It is at the earlier stage, where the ability to make comparisons across sensory modes plays a central role--especially skill in the auditory recognition of words which had been visually presented. For this is the skill which may permit the learner to integrate his new knowledge about visual forms with his existing knowledge of the spoken language, gained through years of listening.

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Table 1

Classification of Variables

	Single Stimulus (SS)	Pair Comparison (PC)
Auditory-Auditory (AA)	20 items	20 items
Auditory-Visual (AV)	20	20
Visual-Auditory (VA)	20	20
Visual-Visual (VV)	20	20

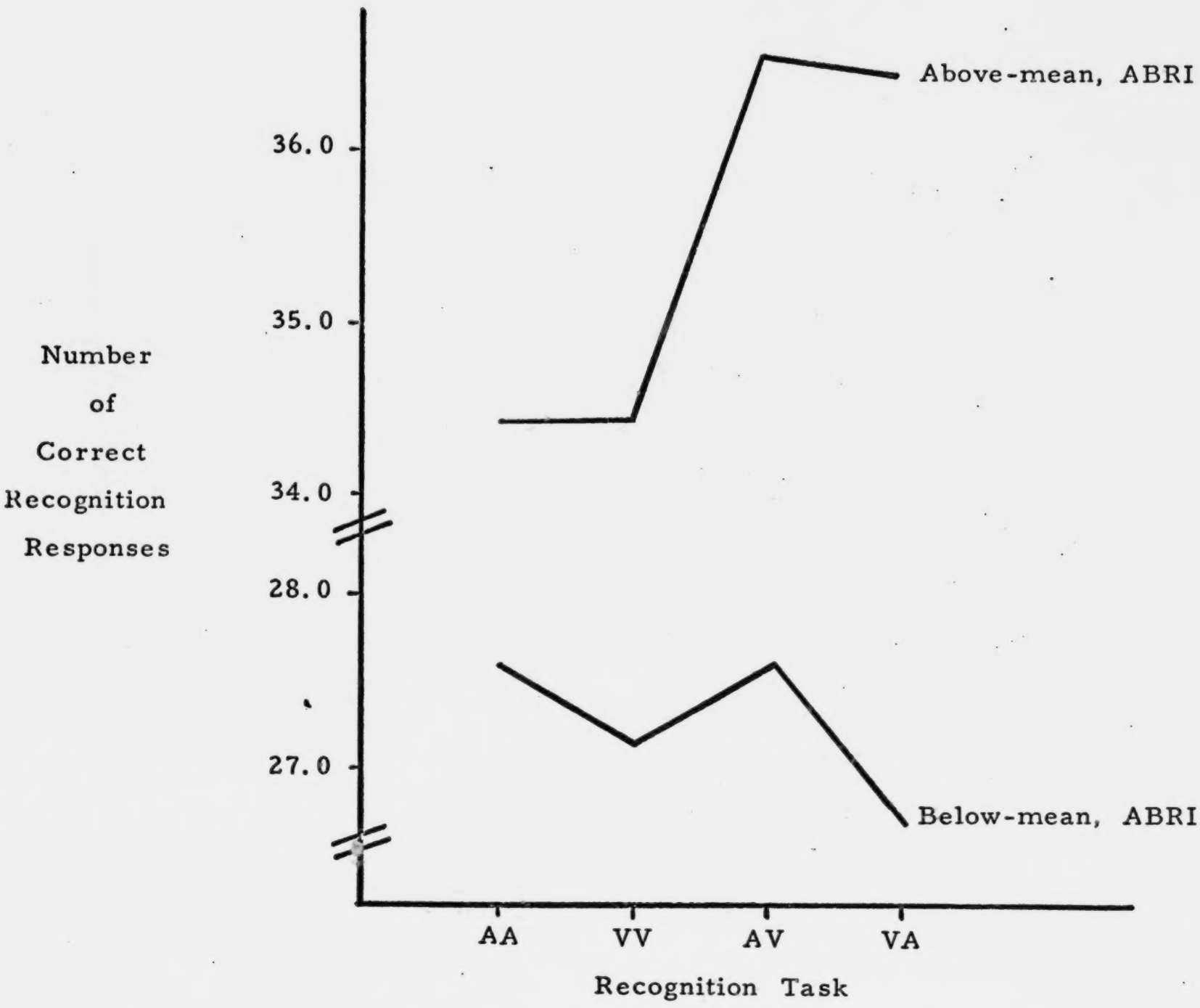


Figure 1. Profiles of scores on the four recognition tasks for two groups of subjects, differentiated on the basis of their performance on the Adult Basic Reading Inventory (ABRI).

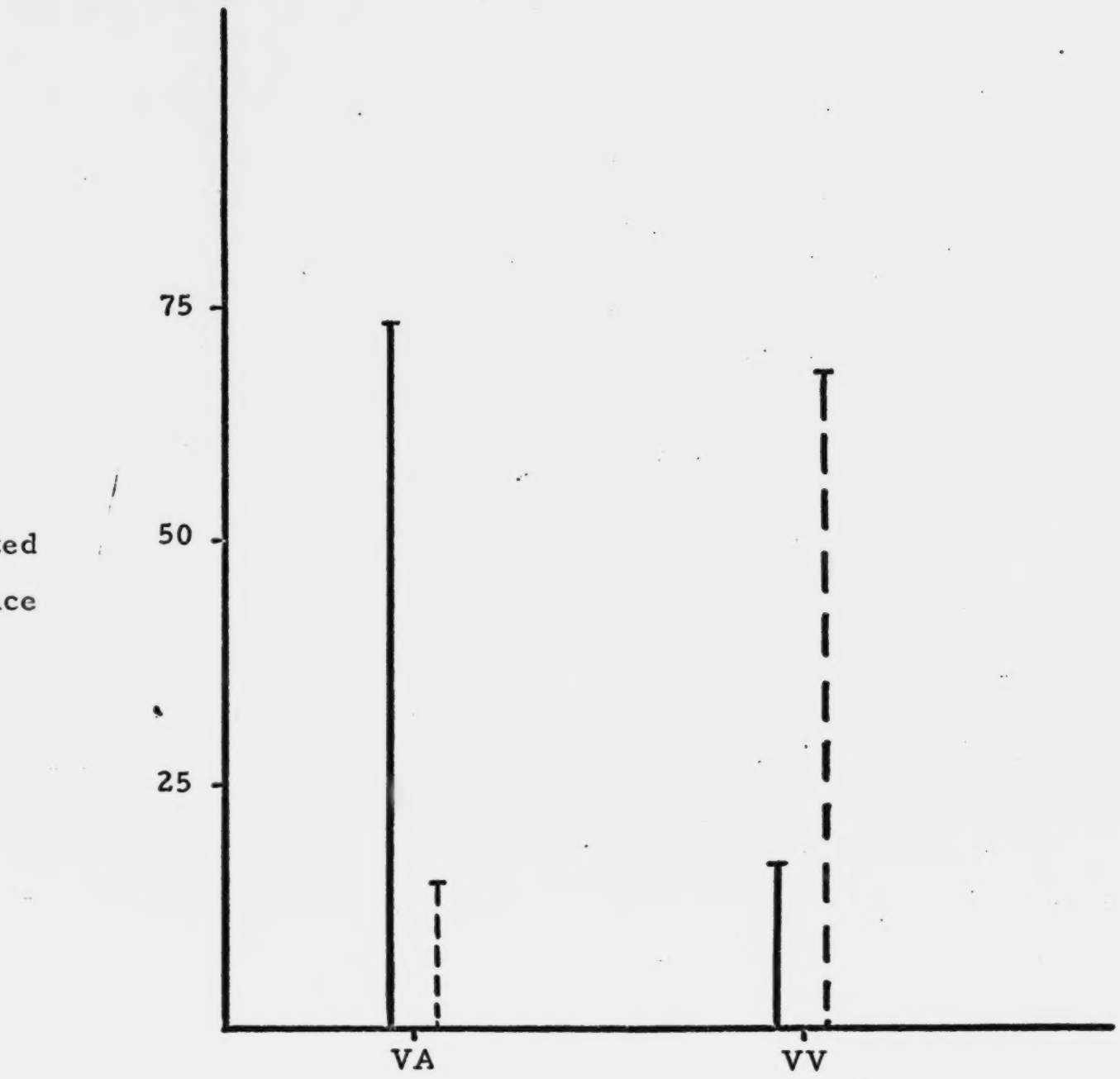
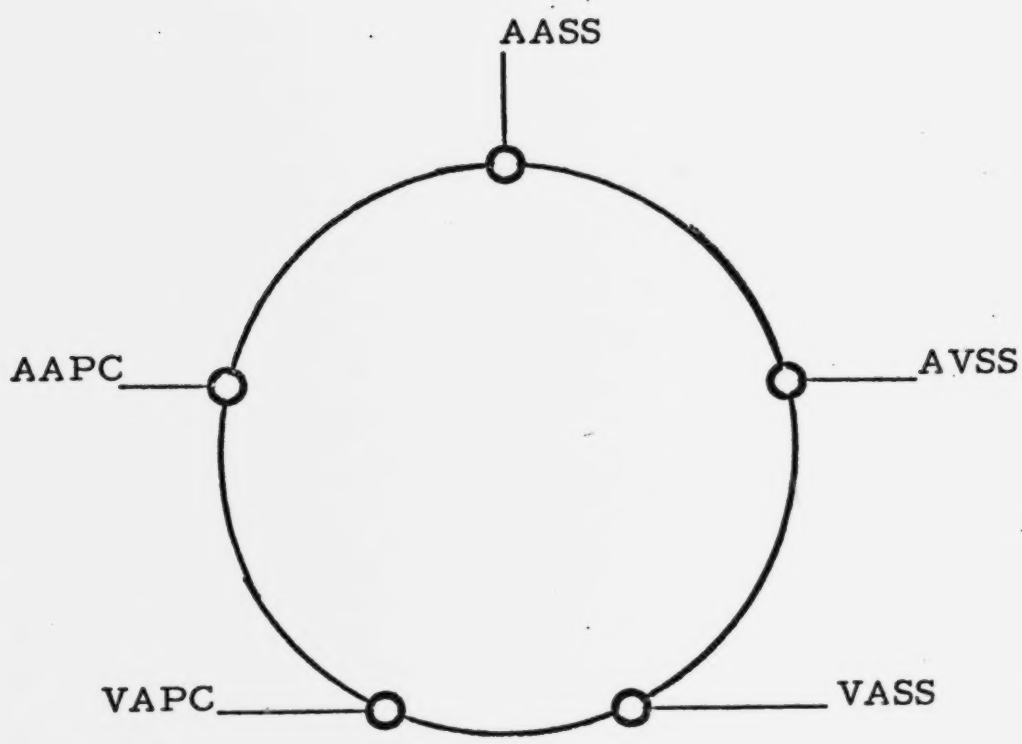


Figure 2. Relative contributions which performance on the VA and VV tasks made toward predicting Ss' reading levels after five months of classroom instruction. Groups were established on basis of ABRI scores at end of instruction.



Circumplex Matrix

TEST	AASS	AVSS	VASS	VAPC	AAPC
AASS	1.000	0.490	0.469	0.478	0.518
AVSS	0.490	1.000	0.638	0.572	0.403
VASS	0.469	0.638	1.000	0.637	0.468
VAPC	0.478	0.572	0.637	1.000	0.691
AAPC	0.518	0.403	0.468	0.691	1.000

Figure 3. A circumplex showing the relationship among various recognition tasks.